People’s Democratic Republic of Algeria

Ministry Of Higher Education and Scientific Research

Abdelhafide Boussouf University Center - Mila

Faculty: Natural and Life Sciences

Department: Common Core in Natural and Life Sciences

Course Title:

STUDY METHODS AND TERMINOLOGY

First year students of Natural and Life Sciences

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Semestre : 1er Semestre

UE: Unité d'Enseignement Découverte

Matière : Méthode de Travail et Terminologie 1

Objectifs de l'enseignement

Aider les étudiants à concevoir les méthodes de recherche et de synthèse des travaux selon les règles scientifiques.

Connaissances préalables recommandées (*descriptif succinct des connaissances requises pour pouvoir suivre cet enseignement – Maximum 2 lignes).*

L'étudiant est sensé avoir des notions en recherche bibliographiques.

Contenu de la matière

- Initiation à la recherche bibliographique
- Rédaction d'un rapport scientifique
- Initiation à la lecture et à la compréhension d'un article scientifique

Mode d'évaluation

Contrôle continu et examen semestriel

Références *(Livres et polycopiés, sites internet, etc)* :

Introduction

This subject aims at learning methods and practices that the student needs throughout their university course, as they are essential for their success. High school education has allowed them to acquire knowledge, while university education encourages them to participate in the creation of knowledge. The main objective of this subject is to train students to develop their autonomy in university life and professional life, especially in written and oral expression techniques (reports, summaries, use of modern communication tools), as well as in the practice of a foreign language.

At university, students are required to extensively research, read, and write. The goal is not to mechanically reproduce established knowledge but to structure knowledge based on relevant, valid, and reliable sources and to develop critical analysis skills. Indeed, this data should only be used if its origin is cited to avoid plagiarism associated with copy pasting. Additionally, in this subject, a range of biology terminology is provided to further familiarize students with the scientific jargon that will be used during their university journey.

General Course Objectives

The primary objectives of the "Study Methods and Terminology" module are:

- Smooth Transition to University: Aid first-year students in adapting to the university system, facilitating a seamless integration into the academic environment.

- Synthesis Methodology Mastery: Develop proficiency in synthesis methodologies, encompassing effective note-taking, articulate public speaking, and the cultivation of consistent and efficient personal work habits.

- Knowledge Utilization Skills: Acquire and hone skills related to the effective utilization and exploitation of knowledge. This includes mastering techniques for conducting thorough documentary research, understanding the proper use and citation of sources, adhering to the standards for creating scientific reports, and delivering compelling presentations of academic work.

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Unit 1: Introduction to scientific Research

Chapter 1: General introduction of terminology

Terminology is the discipline that deals with scientific or technical vocabularies or terms. Its purpose is not only to study how sciences and technologies designate objects and phenomena but also to carry out the identification, organization, and management of terms, particularly in the form of dictionaries and databases.

In our case, it concerns biology or the science of living organisms, which encompasses a part of the natural sciences and the natural history of living beings. This includes animals or zoology, and plants or phytology for vegetation. It also involves cytology for cell function, molecular biology that intersects with genetics and biochemistry, developmental biology of living beings, marine biology concerning aquatic environments, physiology or the examination of the functions of living beings, genetics or the study of DNA, and microbiology, which specifically deals with microorganisms.

Here are some terms used in biology:

-Biology: The scientific study of life and living organisms, including their structure, function, growth, evolution, distribution, and taxonomy.

-Organism: An individual living being, composed of one or more cells, capable of growth, reproduction, and responding to stimuli.

- Cell: The fundamental unit of life, the basic structural and functional unit of all living organisms.

- Species: A group of individuals that can interbreed and produce fertile offspring in a natural setting.

- DNA (Deoxyribonucleic Acid): A molecule that carries genetic instructions for the growth, development, functioning, and reproduction of all known living organisms and many viruses.

- Mitochondria: Double-membraned organelles found in eukaryotic cells, responsible for energy production through cellular respiration.

- Photosynthesis: The process by which plants and other organisms convert light energy into chemical energy in the form of glucose.

- A tissue: A tissue is a set of similar cells with the same origin and participating in the same function.

- Histology: A science (a medical specialty) studies tissues.

- **Cytology:** A science studies the cell.

- **Herbivore:** An herbivore is an animal that primarily feeds on plants and plant-based substances.

- **Pedology:** is a branch of geology and soil science that studies the formation, classification, distribution, and evolution of soils on the Earth's surface. It focuses on the examination of the physical, chemical, and biological properties of soils, as well as their relationship with climate, vegetation, topography, and time.

- **Geology:** is the scientific study of the Earth's solid materials, including rocks, minerals, landforms, and the processes that shape them. It examines the composition, structure, physical properties, and history of the Earth, as well as the processes that have shaped it over millions of years.

- **Plant biology:** is the study of living organisms within the plant kingdom. Its objective is to understand and analyze plant life.

- **Parasitology:** The study of parasites and the diseases they cause in humans, animals and plants.

- **Animal biology:** This is the part of biology that deals specifically with animals.

- **Biophysics:** This is a discipline at the interface of physics and biology, where tools for observing physical phenomena are applied to biological molecules.

- **Biochemistry:** This is the scientific discipline that studies the chemical reactions occurring in living organisms, and therefore in cells.

- **Microbiology:** It is a sub-discipline of biology dedicated to the study of microorganisms.

- **Microorganism:** A microscopic organism, such as bacteria, viruses, fungi, or protozoa.

- **Immunology:** It is the branch of biology that deals with the study of the immune system.

- **Genetics:** It is a sub-discipline of biology; it is the science that studies heredity and genes.

- **A mutation** is a change or alteration in the DNA sequence of an organism. This change can occur naturally or be induced by external factors such as radiation, chemicals, or errors during DNA replication. Mutations can result in variations in traits, characteristics, or behaviors of an organism.

- **Eukaryote** (adjective): This adjective describes cells that possess a nucleus enclosed by a nuclear envelope.

- **Prokaryote:** This adjective describes a unicellular living organism whose cellular structure does not contain a nucleus.

- **A protein:** A biological macromolecule composed by the assembly of a large number of amino acids (typically beyond 100).

- **An enzyme:** An enzyme is a biological catalyst (or a biocatalyst). This molecule is a protein that accelerates (up to millions of times) a chemical reaction that occurs within the organism, either intra- or extracellular.

- **Anaerobic:** "Anaerobic" is an adjective that describes an environment or process that occurs without the presence of oxygen.

- **Aerobic:** is an adjective that describes an environment or process that requires or occurs in the presence of oxygen.

- **An organ:** is a distinct body structure composed of multiple tissues that work together to perform a specific function within an organism. Organs are typically identifiable by their unique shape, structure, and specific location within the body. These structures play crucial roles in maintaining the overall health and functionality of the organism.

- **An organelle:** A specialized cellular component present in the cytoplasm of the cell. Each organelle performs a specific cellular function.

- **Metabolism:** The sum of all chemical reactions that occur within an organism to maintain life.

- **Respiration:** The process of breaking down organic molecules to release energy for cellular activities.

-Peptide: A short chain of amino acids as opposed to a protein, which is defined as a long chain of amino acids; proteins can be cut into peptides by proteases.

-A membrane: is a selective barrier or boundary that separates two compartments or environments. It is typically composed of a thin layer of material, often a double layer of lipid molecules with proteins embedded within it. Membranes are essential in various biological and physical processes to control the passage of substances, such as ions, molecules, and other particles, between different regions. In biological contexts, membranes are crucial components of cells and organelles, playing a fundamental role in maintaining cellular structure and regulating the exchange of materials with the external environment.

- Bioinformatics: The science of managing and analyzing biological data using advanced computing techniques.

-Chromatography: Method to separate mixtures of molecules (e.g., proteins) based on their differential movement through a two-phase system (e.g., a solid support material and a liquid buffer). The movement of each molecule through the two phases is determined by various factors (e.g., size, electric charge, interactions with components of the support material).

-Chromosome: The organized form of DNA found in cells that contains many genes, regulatory elements, and other intervening nucleotide sequences as well as proteins that help give chromosomes their compact structures.

- Electrophoresis: Method for separating mixtures of biomolecules (e.g., proteins, DNA) as they move through a support material exposed to an electric field. The distance each molecule travels depends on its size and electrical charge.

- Replication is the process of making an identical copy or duplicate of something. In the context of biology, it specifically refers to the process of copying DNA (deoxyribonucleic acid) to produce two identical DNA molecules. This is a fundamental process in cell division, where a cell's DNA is replicated to create two identical sets of genetic information, one for each new cell. In the context of data or information technology, replication can also refer to the process of duplicating data or files to ensure redundancy, backup, or distribution across multiple locations or devices.

- Genotype: The complete genetic makeup of an organism determined by the particular combination of alleles for all genes.

- Phenotype: The observable properties, traits, or physical appearance of an organism resulting from the interaction of the genotype with environmental factors.

- A codon: is a sequence of three nucleotide bases (letters) in the genetic code of DNA or RNA that specifies a particular amino acid or signifies the start or stop of protein synthesis.

-Endoplasmic reticulum (ER), in biology, a continuous membrane system that forms a series of flattened sacs within the cytoplasm of eukaryotic cells and serves multiple functions, being important particularly in the synthesis, folding, modification, and transport of proteins . All eukaryotic cells contain an endoplasmic reticulum (ER).

- Ribosome: Cytoplasmic organelle (or found in mitochondria and chloroplasts) composed of several RNA molecules and about fifty proteins, serving as a platform for messenger RNA in the protein synthesis process.

-Transcription: Biochemical process in which an intermediary molecule called messenger RNA (mRNA) is generated based on the genetic information of the DNA.

-Translation: The rewriting of a messenger RNA into a sequence of amino acids, with successive triplets of the messenger RNA, or codons, starting from a start triplet (most commonly AUG), being matched with one of the twenty amino acids according to the genetic code rule.

- An antibiogram: is a laboratory test or a graphical representation of the results of such a test that shows the susceptibility or resistance of a specific bacterial strain to various antibiotics. It provides information about which antibiotics are most effective in treating a particular bacterial infection.

- Antibiotic: a natural or synthetic substance with the ability to inhibit the growth of bacteria.

- Antigens: are molecules or substances, often foreign to the body that can stimulate an immune response. They are recognized by the immune system as potentially harmful, leading to the production of antibodies or other immune responses to neutralize or eliminate them. Antigens can include components of pathogens (such as viruses or bacteria), toxins, allergens, and even certain proteins or molecules from one's own body in cases of autoimmune diseases.

-Antibodies: also known as immunoglobulins, are proteins produced by the immune system in response to the presence of antigens (foreign substances) in the body.

-Multi-resistant bacterium: A bacterium is considered multi-resistant to antibiotics when, due to the accumulation of natural and acquired resistances, it is only sensitive to a small number of antibiotics that are typically effective in therapy.

-Commensal Bacteria: The skin and mucous membranes are constantly colonized by commensal bacteria that do not cause disease unless the host's defences weaken.

- Ecology: The study of the interrelationships between living organisms and their environment.

- Ecosystem: A community of organisms and their physical environment interacting as a unit.

- Biodiversity: The number of different species within a given geographical region.

- Antagonism: The inhibiting action of one substance or organism on another.

- Parasite: Any organism that is intimately associated with, and metabolically dependent upon, another living organism (the host) for completion of its life cycle, and which is detrimental to the host to some greater or lesser degree.

- Carnivore: Organism that eats the flesh of another animal, including insects.

- **Herbivore:** Organism that feeds on plants.

-Omnivore: Organism that feeds on a mixed diet of plant and animal material.

-**Population**: All individuals of one species inhabiting a given geographic area, and usually isolated to some degree from other groups of the same species.

Chapter 2: Scientific Research

1- Meaning of Research:

According to Rajasekar and al. (2006), research is a logical and systematic search for new and useful information on a particular topic. It is an investigation of finding solutions to scientific and social problems through objective and systematic analysis. It is a search for knowledge, that is, a discovery of hidden truths. Here knowledge means information about matters. The information might be collected from different sources like experience, human beings, books, journals, nature, etc. A research can lead to new contributions to the existing knowledge.

Research in common parlance refers to a search for knowledge. Once can also define research as a scientific and systematic search for pertinent information on a specific topic. In fact, research is an art of scientific investigation.

Redman and Mory define research as a "systematized effort to gain new knowledge. Some people consider research as a movement, a movement from the unknown to the known.

2- The Steps of Scientific Research (Systematic View).

Research is systematic in that it follows ordered and logical steps:

-Understand the nature of the problem being studied and identify fields of knowledge related to such a problem.

-Establish the state of the art, meaning to collect and study the literature to understand how other researchers have approached the problem.

-Collect data in an organized and controlled manner to arrive at valid decisions.

-Analyze the data relevant to the studied problem.

-Draw necessary conclusions and make appropriate generalizations.

3- Objectives of Research:

The purpose of research is to discover answers to questions through the application of scientific procedures. The main aim of research is to find out the truth which is hidden and which has not been discovered yet. Though each research study has its own specific purpose, we may think of research objectives as falling into a number of following broad groupings:

-To produce new scientific knowledge

-To enrich existing knowledge

-To make new discoveries

-To provide innovative solutions (improvements) to complex problems

-To investigate the laws of nature (causes/effects that operate on all phenomena)

-To develop new products

-To enhance our lives while considering the state of the planet

-To advance science and knowledge

4- Motivation in research

What makes people to undertake research? This is a question of fundamental importance. The possible motives for doing research may be either one or more of the following:

- Desire to get a research degree along with its consequential benefits.

- Desire to face the challenge in solving the unsolved problems, i.e., concern over practical problems initiates' research.

- Desire to get intellectual joy of doing some creative work.

- Desire to be of service to society.

- Desire to get respectability.

However, this is not an exhaustive list of factors motivating people to undertake research studies. Many more factors such as directives of government, employment conditions, curiosity about new things, desire to understand causal relationships, social thinking and awakening, and the like may as well motivate (or at times compel) people to perform research operations

5- Characteristics of Research:

Research is a process of collecting, analysing and interpreting information to answer questions. However, to qualify as research, the process must have certain characteristics: it must, as far as possible, be controlled, rigorous, systematic, valid and verifiable, empirical and critical.

- **Controlled**: In real life, many factors affect an outcome. The concept of control implies that, in exploring causality in relation to two variables (factors), you set up your study in a way that minimizes the effects of other factors affecting the relationship.

- **Rigorous**: you must be scrupulous in ensuring that the procedures followed to find answers to questions are relevant, appropriate and justified. Again, the degree of rigor varies markedly between the physical and social sciences and within the social sciences

- **Systematic**: this implies that the procedure adopted to undertake an investigation follow a certain logical sequence. The different steps can not be taken in a haphazard way. Some procedures must follow others.

- **Valid and verifiable:** this concept implies that whatever you conclude based on your findings is correct and can be verified by you and others

- **Empirical:** this means that any conclusions drawn are based upon hard evidence gathered from information collected from real life experiences or observations.

- **Critical:** critical scrutiny of the procedures used and the methods employed is crucial to a research enquiry. The process of investigation must be fool proof and free from drawbacks. The process adopted and the procedures used must be able to withstand critical scrutiny. For a process to be called research, it is imperative that it has the above characteristics.

6-Types of Research:

Research can be classified based on time, purpose, settings, place and technique. Some researchers have similarities and some have little variations. However, all the types of research have its own significance.

6-1- Basic Research: It is also called as pure research. Research for the sake of enhancement of knowledge is termed as Basic Research. It is done with the intention of overpowering of the unknown facts. It is concerned with the generalizations and with the formulation of new theory. Basic research may not produce solutions or results to the present problem but it contributes something to the scientific knowledge. However, its work may have zero importance, but it may become useful in the future.

6-2- Applied Research: It is also called as practical research or „need based" research. The main intention is to find solutions to the current problems being faced by an institution, society, business or in government offices. Research to identify social, political and economic changes, which has adverse effects in different sectors are some of the examples of applied research. This type of research is mainly carried on with the secondary data.

6-3-Empirical Research: It is often referred to as experimental research. In this primary data is collected, analyzed, interpretation is done and subjected to hypothesis testing. Researcher should develop his experimental designs and should provide working hypothesis before the commencement of his research for good output.

6-4-Qualitative Research: As the name itself suggests, this research is concerned with the qualitative process. It generally works with the study of human behaviour. By this research, one can find the body language, attitude, opinions, feelings etc. from the opposite person through observation. It is mainly helpful for Psychiatrists and interviewers. Many techniques are being used like word association test, sentence completion, drawing pictures, Thematic Apperception Test. It is needed in times where quantitative research does not work. Hence, it is also called as „Motivation Research".

6-5-Quantitative Research: This research is mainly concerned with the measurement of phenomenon in terms of quantity. Many a times a debate is conducted between qualitative and quantitative terms. An example for the quantitative research is carrying out senses for collecting population, social, economic statistics of a particular area. They are subjected to statistical analysis. It relays mainly on primary data like survey method and questionnaire method. However, one can observe the inter-dependence between one another.

6-6-Descriptive Research: As the name itself indicates, this research directly deals with description. It includes different data collection like survey method and fact-finding techniques. The main character of this research is that, the researcher does not have control over the variables. He should describe what has happened and what is happening. Most Ex post facto projects use descriptive research.

Chapter 3: The Steps of the Scientific Investigation Process

1- Some Definitions:

-The scientific method: it is the set of rules and procedures to follow in order to achieve objectives and conduct scientific research. Therefore, the method is defined as the set of intellectual operations that allow for the analysis, understanding, and explanation of the studied reality.

-The scientific approach: it is the set of steps to follow in order to conduct scientific research (it is the way to progress towards the defined goal or subject).

-Methodology: it is the science of method. Methodology is the set of methods and approaches in a particular field, adopted by specialists such as researchers, linguists, editors, teachers, etc., to conduct scientific research.

-Methods: Research methods encompass all the techniques and approaches employed in conducting research. These methods refer specifically to the practices researchers utilize while carrying out their investigations. Essentially, any techniques used by a researcher to explore their research problem are classified as research methods. In the context of research, especially applied research, the primary goal is to find a solution to a specific issue. Therefore, it is essential to connect the available data with the unknown aspects of the problem to facilitate finding a viable solution.

-Technique: it is the set of tools, instruments, and means specific to an activity or research.

2- The steps of the scientific investigation process

2-1-Observation:

Scientists are individuals who observe the world in which they live. They can observe it with the naked eye or use tools such as magnifying glasses, microscopes, telescopes, or other measuring devices.

2-2- State the problem to be solved:

The scientific method starts when you ask a question about something that you observe how, What, When, Who, Which, Why, or Where? The problem is always stated in the form of a question.

For a science fair project, some teachers require that the question be something you can measure, preferably with a number. Here are some characteristics of a good question:

- The question should be interesting enough to read about
- There should be at least three sources of written information on the subject. You want to be able to build on the experience of others!
- The question should contain one factor (variable) that you can change in your experiment and at least one factor (variable) that you can measure.

2-3-Propose hypotheses:

A hypothesis is an educated guess about how things work. It is an attempt to answer your question with an explanation that can be tested. A good hypothesis allows you to then make a prediction:

"If _____[I do this] _____, then _____[this]_____ will happen.". The hypothesis is always stated in the affirmative form.

2-4-Stating the verifiable consequence of the hypothesis

To state a verifiable consequence, two important points must be respected.

1) It is assumed that the hypothesis is correct.

2) In this case: IF we vary a parameter, THEN we will observe a certain phenomenon.

The verifiable consequence allows:

a. to anticipate the experiment or research that will need to be conducted to test the hypothesis

b. to predict the results to be obtained for the experiment to validate its hypothesis

The verifiable consequence is always stated in the form: "If ..., so ... ."

2-5- Designing the experiment to test the hypothesis

Once a problem has been defined and one or more hypotheses have been proposed, the scientist turns his or her attention to testing the hypotheses. An experiment involves defining variables, outlining a procedure, and determining what control treatment to be used as the experiment is performed. Once the experiment is defined, the investigator predicts the outcome of the experiment based on the hypotheses. A crucial step in designing an experiment is identifying the variables involved. There are three categories of variables: dependent, independent, and constants.

A- The Dependent Variable

The dependent variable is what the investigator measures (counts, records). It is what the investigator thinks will be affected during the experiment. For example, the investigator may want to study soybean growth. There are several measurable characteristics of soybean growth such as height, weight and soybean production. For any experiment, there may be a number of possible dependent variables. The investigator must choose the one or ones that he or she thinks is most important. More than one dependent variable may be chosen.

B- Independent Variable

The independent variable is what the investigator varies during the experiment. It is what the investigator thinks will affect the dependent variable. Unlike the dependent variable, the investigator must choose only one independent variable to investigate. For example, if the scientist wants to investigate the effect that the amount of fertilizer has on soybean growth, the scientist will use different amounts of fertilizer. The scientist can measure, as many dependent variables as he or she thinks are important in indicating soybean growth. Remember, there may be several dependent variables, but there may be only one.

C- Constant(s)

Since there can be only one independent variable, all independent variables other than the one being studied must be held constant so that they do not affect the outcome of the experiment. For example, consider an experiment studying fertilizer effects on soybean growth, where the scientist has chosen the amount of fertilizer as the independent variable. The scientist must be sure that there are no differences in the type of fertilizer used. Many other variables have to be held constant in this experiment. All plants should be the same and have the same light exposure, soil type, amount of water and temperature. It is impossible to hold everything constant, but scientists try to control as much as they can.

2-6-Communicating the obtained results

Once your experiment is complete, you collect your measurements and analyse them to see if they support your hypothesis or not.

Scientists often find that their predictions were not accurate and their hypothesis was not supported, and in such cases, they will communicate the results of their experiment, then go back, and construct a new hypothesis and prediction based on the information they learned during their experiment. This starts much of the process of the scientific method over again.

Even if they find that their hypothesis was supported, they may want to test it again in a new way.

Various means of communication include:

- Diagrams.

- Result tables.

- Observation drawings.

- Graphs.

- Digital images.

The results should be annotated (captions, titles, different stages...).

2-7-Analyzing the results

This is a phase of reasoning where the obtained results are compared with the verifiable consequence. The purpose of analysing the results is to validate or invalidate the initial hypothesis. The reasoning in the analysis should be structured and may rely on knowledge to interpret (understand) the results effectively.

2-8-Conclusion

To conclude the work, the scientist must formulate a clear and precise answer to the problem they posed.

Unit 2: Writing a scientific report

Chapter 1: Introduction to Bibliographic Research

1. Definition of Bibliographic Research

Bibliographic research is the set of steps that enable the search, identification, and retrieval of documents related to a specific topic through the development of a search strategy. There are various methods for defining an effective documentary research strategy, all of which are based on some key principles that we will explore in succession.

2. Purpose of bibliography:

- The primary purpose of a bibliography is to help users find books and materials of interest. For researchers, it allows them to discover existing literature on their subject, staying informed and preventing duplication in their work, ultimately saving time and money.

- The secondary purpose of a bibliography is to assist in selecting books and verifying bibliographic information, as well as locating materials in libraries or for purchase. Readers often use bibliographies to find resources on specific subjects in various formats. The effectiveness of a bibliography depends on the organization creating it, and there are various types of bibliographies with varying objectives.

3-Steps in Bibliographic Research

There are various methods for defining an effective bibliographic research strategy, but they all rely on a few key principles. It will revolve around four successive steps:

3-1- Investigation Phase:

It involves gathering the necessary documentation for processing the topic, including accessing databases, consulting manuscripts, conducting surveys, and more. This step should enable the formulation of the research question, identify documentary requirements, and select the necessary concepts/keywords for querying documentary sources.

3-2- Analysis Phase.

This phase involves creating a detailed plan for the intended research.

3-3- Documentation Phase.

It involves sorting and organizing the data and useful elements obtained during the investigation phase. The objective is to consult ordered cards (bibliographic, citation, and thematic) in preparation for writing.

3-4- Writing Phase.

It involves putting in writing the ideas and data organized on the cards following a progressive plan of presentation. The objective is to write paragraphs and sections following a logical structure.

4- Criteria for evaluating the quality and relevance of sources.

In the face of the abundance of documentation, what needs to be mastered is the sorting of information and the delineation of useful resources. To do this, the research student must immediately combine several types of selection criteria:

- Searching by domain-specific keyword (Biology, Chemistry, Physics, Electronics, etc.);

- Searching by keyword in the title or author's name;

- Searching by keyword related to the topic, ensuring a specific research focus;

- Searching within the document's title: for a book, this would be the title listed on the title page;

- Searching in the abstract: it is typically found in most bibliographic records from databases, at the beginning or end of journal articles, and often on the back of books (back cover).

-Searching in the table of contents: it allows for a better understanding of the content (structure and logic of the argument) and helps identify relevant chapters.

- Searching within tables, graphs, etc.: they can aid in understanding the subject and be useful for your work.

-Introduction and conclusion: Consulting these sections helps in understanding the initial question and the author's conclusions.

5- Different types of documentation:

Information serves as the fundamental resource for applying documentary techniques. It can appear in various forms, ranging from concrete to abstract: a piece of information, a fact, a figure, an image, or a sound. This data can be duplicated and shared using tangible media, such as voice, newspapers, films, books, or digital documents on the Internet. Information channels can be categorized in different ways, but we'll focus on a classification based on the type of elaboration: primary and secondary.

Primary documents provide direct information; secondary documents compile primary documents (like printed or digital catalogs, bibliographies, etc). Each document type can be

identified by specific bibliographic characteristics, which are essential for creating accurate bibliographic descriptions.

5-1- Primary documents:

A- **Book:** The book has long been a privileged source of information. In past centuries, it could contain all knowledge within beautifully crafted encyclopedias. The book existed long before the invention of the printing press (mid-15th century). On papyrus, parchment, or paper, people have been recording information in writing since antiquity to share and disseminate it.

B- **The periodical and its structure**: Sometimes called a journal, a periodical is a publication that appears at regular intervals, providing information on current events. It is a permanent source of information.

C- **The collective work**: A collective work lies somewhere between a periodical and a book in terms of its design. It is made up of articles written by various authors, typically experts in the same field, all compiled into a single volume. Its bibliographic description can take on different characteristics:

- If the bibliographic reference is descriptive, it focuses on the collective work as a whole;

- If the bibliographic reference is analytical, it highlights the contribution of an individual author, including details about the source (the collective work itself).

D- **Conference proceedings:** Conference proceedings are a particular form of collective work. The articles within this document are the written versions of lectures and presentations delivered at a conference or scientific gathering. The scientific editor, who may also be the event's organizer, serves a similar role as in a collective work. In a bibliography, the document's title should ideally be accompanied by:

- The name of the conference;
- The date of the event;
- The location.

5-2-secondary documents

The research work was long and tedious. Currently, computerized systems have largely replaced them. Only a few very specialized printed bibliographies or those from specific collections remain.

The electronic tools are primarily:

- Catalogs.
- Abstract databases.
- Analytical bibliographies.

These tools refer to scientific documents, either printed or increasingly accessible online.

6- Methodology of bibliographic research

6-1-Phase of designing and constructing the study object

To successfully carry out research, one must carefully plan, reflect, precisely identify a problem, formulate a central question (strengthened by others), imagine appropriate answers (hypotheses), and consider their validity. The steps of the object construction phase are as follows:

6-1-1-Select and formulate a research problem

Drawing on readings (consulting books and works) and preliminary field observations, the researcher formulates a research problem. In other words, they develop and articulate, through a sequence of arguments, the translation of a major concern, the expression of "what is problematic" and "what constitutes a problem" and is worthy of study and elucidation. This involves stating the research questions, objectives, research hypotheses, and potentially the thesis position.

6-1-2- Counting the relevant books and works

In this section, the researcher demonstrates a good understanding of other authors and works that have, in one way or another, addressed the field and research subject that are relevant to their own study.

6-1-3- Develop a framework of reference

In principle, the framework of reference defines the particular theoretical perspective through which the research problem will be approached and addressed, placing the study in a context of significance.

6-2- Methodological or Discovery and Data Collection Phase.

During this phase, the researcher explains and justifies the methods and instruments they will use to understand and collect data in response to the questions posed and hypotheses

formulated. The researcher also specifies the characteristics of the population (human or non-human group) they will work with and from which they will extract information.

Finally, they describe the data collection process and outline the data analysis plan.

6-2-1- Selection of Data Collection Methods and Instruments

At this stage, the researcher presents or outlines the methods they will employ and then describes the instruments or techniques that will be used. Various instruments are used to measure the study variables. These instruments can provide qualitative information (interviews, observations, etc.) or quantitative information (questionnaires, measurement scales, etc.).

6-2-2- Definition of the Study Population and Sample

The researcher characterizes the population by establishing the selection criteria for the study, specifying the sample, and determining its size. The accessible population is the portion of the target population that is within the researcher's reach. It can be limited to a region, a city, a company, an agency, a department, etc. A sample is a subset of elements or subjects drawn from the population, selected to participate in the study.

6-3-Data Processing Phase (Analysis/ Presentation and Interpretation/ Discussion of Results)

A substantial amount of collected data (for example, two boxes of a thousand filled questionnaires, ten tapes, or gigabytes of recorded interviews) does not, on its own, constitute research. All this data needs to be processed. This means conducting an analytical process to isolate meaningful units (themes, patterns, variables...) abstracted from their context to perform a term-by-term comparison. Subsequently, the researcher synthesizes this information. This phase consists of two steps:

6-3-1-Data Analysis and Presentation

Data analysis depends on the type of study and its purpose, whether it involves exploring or describing phenomena, or understanding and verifying relationships between variables. Statistics are used for quantitative analysis. Qualitative analysis involves gathering and summarizing non-numerical data in a narrative format. Data analysis helps produce results that are interpreted and discussed by the researcher.

6-3-2-Interpretation and Discussion of Results

Since the data is analysed and presented using narrative texts, tables, graphs, figures, and other means, the researcher explains them in the context of the study and in the light of previous

research. Starting from the results, the researcher discusses their authenticity, revisits the hypotheses, appropriately references theories and authors who have addressed the studied issue. This process allows for making inferences, drawing conclusions, developing a theory, and providing recommendations.

7-Command Languages

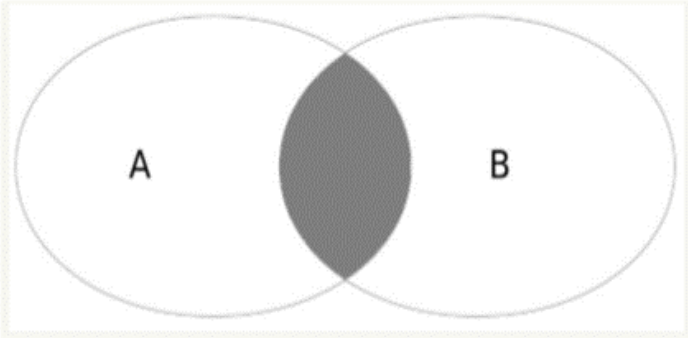
A command language consists of a set of commands to be entered into a document system (catalog, bibliography, table of contents, search engine, etc.) to ask questions, view, and select references.

7-1-Boolean Operators

Based on Boolean algebra, they allow for the combination of multiple search elements to refine or broaden a query.

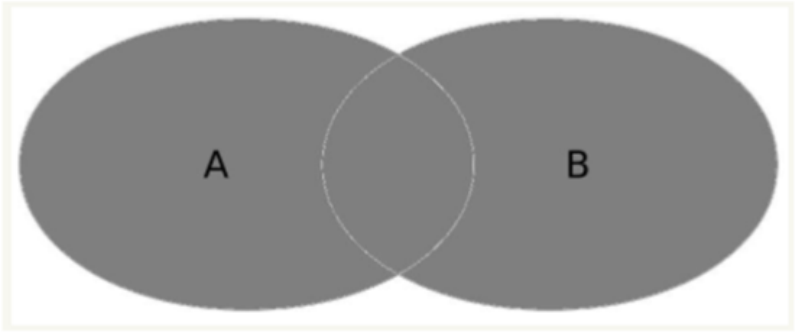
There are three operators: AND, OR, and NOT."

AND: The AND operator represents an intersection. With the AND operator, the displayed references contain both term A and term B. If either term is absent, the reference is rejected. Displayed references must belong to both sets



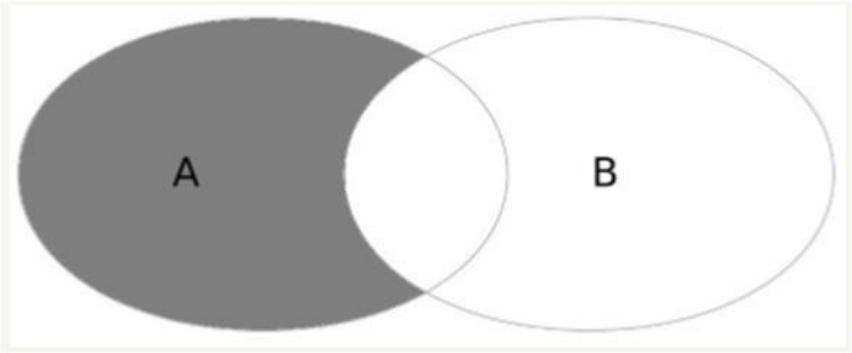
The AND operator has the effect of reducing the number of responses to a question. It is used to refine a question. For example, to search for a document on tomato diseases, one would use the query: 'disease AND tomato'

OR: The OR operator represents a conjunction. With the OR operator, the displayed references contain at least one of the terms in the equation. The displayed references belong to one or more sets.



The OR operator has the effect of increasing the number of responses; it combines the results from different sets. It is used to include synonyms in a search query. For example, to search for documents on wheat, one would use the query: 'wheat OR triticale OR blé

NOT: The NOT operator represents exclusion. With the NOT operator, the displayed references contain term A but not term B. All references in set A that also contain term B are eliminated.



7-2-Exact Phrases and Proximity Operators

When searching for documents about the "greenhouse effect," you can ask the question: "effect AND greenhouse." The results will include documents about the "greenhouse effect," but also documents about the "effect of continuous watering on greenhouse growth," which does not match the original question.

Two tools are available to refine the query: **exact phrases** and **proximity operators.**

An exact phrase is represented in documentary language by the use of quotation marks. You can enforce a multi-term search simply by using quotation marks, for example: "greenhouse effect." This operator works with nearly all existing tools.

Proximity operators allow for more precise searching within a text (title, abstract, etc.). They are only available in certain bibliographic databases. There are two groups of commands:

commands that impose a specific order of appearance of terms and those that do not consider the order of appearance. Some common commands you may encounter include "ADJ," "W," "WITHIN," "NEAR," "SAME," or "N," followed by an optional number.

"ADJ": Stands for adjacent. It requires that the terms appear next to each other in the specified order.

"W" or "**WITHIN":** Specifies that the terms should appear within a certain range of each other.

"NEAR": Requires the terms to be in close proximity, but it is more flexible than "ADJ" or "W."

"SAME": Specifies that the terms must appear in the same order as provided.

"N" followed by a number: This indicates the maximum number of words allowed between the terms.

7-3-Parentheses

Parentheses can serve two different functions.

Traditionally, they are used to separate elements in a query. For example: "apple* AND (scab OR preservation OR mold*)" is equivalent to "(apple* AND scab) OR (apple* AND preservation) OR (apple* AND mold*)".

With certain tools, terms within parentheses are considered to be linked with the "OR" operator, while those outside are linked with the "AND" operator. For example, the query above can be translated as "apple* (scab preservation mold*)".

Chapter 2: Referencing

1-Referencing and Bibliography

In writing books, thesis or any other papers we may recite the findings or workings of others. It is notes in to cite others in the study, If we use others contribution in the study we must acknowledge them both in text and in Reference.

Referencing

Referencing is an author-date system used in the academic community to indicate the source of ideas, theories, quotes, facts and any other evidence and information used to undertake an assignment or thesis or paper.

Bibliography

Bibliography is a list of authors and their contributions used in the study. It enables the readers to find out the original items.

2-Why do you need to reference others work in your paper?

-To avoid plagiarism, a common form of academic theft.

-Referencing correctly because it gives appropriate credit to the sources and authors.

-Referencing the sources that you have used for your assignment demonstrates that you have gone through wide-ranging research in order to complete your work.

-Referencing enables the reader to find out the original items that you have used.

What should be referenced?

- Direct quotations put in inverted comma

- Any information, ideas or data, obtained from another author, be it a direct quotation or paraphrased comment

- Definitions of terms, if necessary

3-Plagiarism

Plagiarism is defined as to "the practice of taking someone else's work or ideas and passing them off as one's own". Any of the following acts constitutes plagiarism unless the work is appropriately acknowledged:

- copying the work of another student;

- Directly copying any part of another's work;

- summarising the work of another;

- using or developing an idea or thesis derived from another person's work; or

- using experimental results obtained by another.

4-The principles of bibliography.

- Each type of document has its own citation rules. Indeed, the important information to cite varies depending on whether it is a book or a web page.

- No matter which standard is chosen, a bibliography must be consistent: all journal articles should follow the same citation rules. It is very detrimental not to adhere to this principle of consistency. The purpose of this standardization is to make a series of information understandable. Thus, even if the reference of the work is in another language or even in a different alphabet, the reader will be able to identify the author's name, the title, the year, etc., even if they don't understand the language. Failing to adhere to the chosen standard makes the bibliography less readable.

- At the very least, you should always include the name of an author, the title of the document, and its publication date. These are the most important elements, but edition and pagination can complement this information and even provide an idea of the quality of the cited work.

- A bibliography is organized: either in alphabetical order of authors, in the order of appearance in the body of the text, by theme, or by document type. Since a bibliography reflects a research process, but more importantly, the choices made in terms of information sources, it needs to be organized.

5- Citation standards by document types.

5-1- Authors

- If a single author: (Author's Last Name, Year of Publication)

- For two authors: (First Author's Last Name & Second Author's Last Name, Year of Publication)

- For more than two authors: (First Author's Last Name et al., Year of Publication)

5-2- The publication date

- A document may have multiple dates: its publication date, the date it was printed, the legal deposit date, etc.

- You should only use one date; if not, use the most recent date

5-3- Printed or Digital Version?

- There is no difference in content between a digital version and a printed book of the same edition.

- Bibliographic citations for both versions will include the same information.

- However, since the digital version is more easily accessible but also subject to potential changes, additional information may need to be added to facilitate access to the resource.

- Example: Citing an e-book: AUTHOR'S LAST NAME, First Name. Title. Volume **[online].** Edition statement. Place of publication: Publisher, year of publication **(date of access),** page range (Title of the collection, number in the collection). **Available at: URL"**

6-Three styles of referencing

1. Harvard System

2. APA System (American Psychological Association)

3. Vancouver or Footnotes System

Harvard System

The Harvard System is an author-date system of referencing within text and bibliography. It was developed at Harvard University in the 1930s. It uses author(s) name and date within the text and details in the Reference or Bibliography.

APA System (American Psychological Association)

The American Psychological Association (APA) System is a variation on the author-date system of referencing within text and bibliography.

It was published in 2001 at the Publication Manual of the American Psychological Association.

Vancouver or Footnotes System

Vancouver referencing system is number wise referencing system at the bottom of the page of the paper. The number directly refers to the sources of information.

In Vancouver style, up to six authors, the names of all the authors are written. If there are more than six authors, then after writing the first six authors, ‘et al’ is used. This style recommends the use of official abbreviations for titles of journals (if available). While using Vancouver style,

if an author's name is to be used in text, it is mandatory to use the citation number as well. For example, as Kaur2 emphasized the high prevalence of depression in elderly. If there is more than one author it is recommended to use term "et al" after writing the sir name of first author.

7- Examples of referencing

7-1-Referencing printed books

a- Single topic (monograph) books

1-The last name(s) of the author(s)

2- the initial letters of first names

3- the year of publication in brackets

4-the book title (in italics or underlined – but be consistent whichever you decide)

5-list the location (town or city) of the publisher

6-finally the name of the publisher.

Ex: Citation (one author): (Handy 1994)

Reference: Handy, C. (1994). The Empty Raincoat: Making Sense of the Future. London: Hutchinson.

Citation (several author) : (Saunders *et al* 2003)

Reference: Saunders, M., Lewis, P., and Thornhill, A. (2003). Research Methods for Business Students, 3rd edition. Harlow: FT Prentice Hall.

7-2-Referencing a chapter from an edited book

Some books are not written by a single author, but contain articles or chapters written by different authors. These are edited collections, sometimes called 'readers' and have one or more editors.

If you make reference to an author in an edited collection, you need to give the last name, initials, date of publication, title of chapter (inverted commas), name(s) of editor(s), title of book (in italics or underlined), then location of and name of publisher, and page numbers.

Ex: Citation (two authors) : (North and Leigh 1983)

Reference: North, D., Leigh, R. (1983) 'Monitoring Industrial Change at the Local Level: Some Comments on Methods and Data Sources', in M. Healey (ed.) Urban and Regional Industrial Research: The Changing UK Data Base. Norwich: Geo Books, pp.111-29.

Citation: (Moorhouse 1984)

Reference: Moorhouse, H.F. (1984). 'American Automobiles and Workers' Dreams', in K. Thompson (ed.) Work, Employment and Unemployment., Milton Keynes: Open University Press, pp.80-89.

7-3- Referencing Journal Articles, Magazines and Newspapers

Start with the last name of the author of the article, initials of author, year of publication (in brackets), title of article, name of the journal or magazine (in italics or underlined), volume number and part number (if applicable) and page numbers.

Example

Citation: (Bosworth and Yang 2000).

Reference: Bosworth, D. and Yang, D. (2000). Intellectual Property Law, Technology Flow and Licensing Opportunities in China, International Business Review, vol. 9, no. 4, pp. 453-477.

MAGAZINES

The same sequence of referencing academic journals applies to magazines with a general readership.

-If there is an author, start with his or her last name, followed by their initials

-Year of publication (in brackets)

-If there is no author name, start with the originator's name (as recommended by BSI); this would be the name of the magazine (in italics)

-The title of the article (in inverted commas)

-If you started with the author's name, give the title of the magazine at this point (in italics, or underlined)

-Then full details of the specific date the magazine was published

-Page numbers

Examples (with and without authors from the same magazine):

Citation: (Rigby 2005)

Reference: Rigby, R. (2005). 'Crossover Consultants'. Management Today, November 2005, pp.30-35.

Citation: (Management Today 2005)

Reference: Management Today (2005). 'Business Manners, Working From Home'. November 2005, p.12.

NEWSPAPERS

The order of referencing is:

-Name of writer, if shown (if name of writer not given, start with the name of the Newspaper (in italics)

- Year of publication

- Title of article

- Name of newspaper (in italic or underlined)

- Day of publication

- Detail of any special identifying feature, e.g. review sections, supplements

- Page number

Examples:

Citation: (Saigol 2005)

Reference: Saigol, L. (2005). 'Gift shoppers set to spend £150m daily online'. Financial Times, 12/12/2005, p.4.

Citation: (Financial Times 2005)

Reference: Financial Times (2005). 'Duke does U-turn over spin-off sale'. 12/12/2005, p.14.

Citation: (Skypala 2005)

Reference: Skypala, P. (2005). 'Shooting the rapids of pension liabilities'. Financial Times: FTfm (Fund Management), 12/12/2005, p.3.

Citation: (Financial Times 2005)

Reference: Financial Times (2005). 'Helping fashion to embrace IT'. FT Companies and M

Chapter 3: Writing a thesis

1-Definition of the thesis: It is a scientific document prepared according to specific rules (theoretical, methodological, and practical) that marks the culmination of years of study and enables the student to obtain a degree.

2-What do we need to write a thesis?

• Planning and time management skills

• Critical reading skills

• Academic writing skills

• Internet searching skills

• Resources classification

• Referencing skills

• Data analysis skills

• Software's skills (e.g. word, excel, origin etc.)

3-Usual Thesis structure

a-The Cover Page (Mandatory)

The cover page must include the following information:

- The name of the affiliated university, institute, faculty, and department.

- The statement "Thesis/Dissertation for the Degree of Bachelor's/Master's/Doctorate in: (Specialty), the title of the thesis/dissertation.

- The student's full name with the mention "Presented by:"

- The mention in front of the jury: indicating the names and academic titles of each jury member in the following order: chairperson, supervisor, and examiners.

- At the bottom, the defense date or the month and year of the academic year.

b- Abstract

• The abstract is the hardest part of the thesis to write and most readers of the thesis will read it first

• The abstract conveys the most important messages regarding your project, such as: what you set out to do? How did you do it? What results were obtained?

A good abstract has to:

• Be precise and honest

• Stand alone

• Use no technical jargon

• Be brief and specific

• Minimize the use of abbreviations

• Cite no references

C- Acknowledgements

Writing a thesis or dissertation requires a lot of energy, motivation, and conviction. However, a thesis or dissertation is not always done "alone." It is customary to express gratitude to the people around you who have contributed, directly or indirectly, to the thesis or dissertation. Of course, acknowledgments are optional. They typically serve as a token of appreciation for loved ones and the thesis or dissertation supervisor. Students who wish to emphasize this can do so simply and effectively in one or two paragraphs on a separate page, just before the table of contents.

As for the dedication, which is also written before the table of contents, it represents a tribute to one or more individuals who are of great significance to the candidate. It is also, of course, optional.

D- Tables of contents, list of tables and graphs

E- Introduction chapter

- Introduce the reader to the particular problem your project is attempting to solve.

- Most projects have multiple objectives. it is a good idea to state these in a numbered list.

Generally, the introduction chapter should contain:

• Background for the work

• The importance and significance of the work

• Include brief descriptions of the development process, design, implementation, and testing approaches

• Provide a synopsis of what the other chapters contain

• By the time the reader has finished reading the Introduction s/he should have a clear understanding of the problem you set out to address and how it has been solved

F- Background & literature review Chapter

This chapter is mandatory

• It focuses on issues that are more specifically related to the work in your project.

• Describe similar work done by others in the past in the literature.

• Proof that you have done a literature search and completed a critical analysis

of the relevant literature describing prior work in the field.

• Demonstrate this by writing some discussions on what others have done,

what they have achieved, and limitations of their work.

• Do not copy and paste text from the literature; paraphrase the contents inyour own words.

G- Research Methodology

-Describing the materials used in your research project

-Explaining how the materials were prepared

-Describing the techniques that you used

-Explaining how measurements were made and what calculations were performed

-Explaining how the setup was calibrated and the limitation of your method

H-Results and Discussions chapters

- Use figures and tables to summarize data

- Comment on the results obtained

- Interpret what the results mean

- Identify any sources of error in your measurements

- Explain any results which are unexpected

- Define the limitations of the method

I- Conclusion

- Summarize the problem you set out to solve, describe what you have achieved, and prospect for future work

- Refer back to the problems you encountered and how you overcame those, or found workarounds.

- The conclusion section should not contain detailed descriptions of the problems or the solutions

- Address how you have met the original objectives of the project (i.e. proposal contents)

- Discuss potential future work

J-Appendices (if needed)

-Use Appendix to present material that will interrupt the flow if included in the main part of the thesis.

k- References

-Use either Harvard referencing style or Vancouver Style BUT not BOTH

- Learn how to Use Endnote referencing software

- Learning Endnote will save your efforts and time.

4 -Post writing

Here are the various elements of this final step:

- Selection of the final title

- Formatting of the thesis

- Review and correction of the document

- How to print the thesis

- Preparation for the thesis defense.

5- Prepare and succeed in your thesis defense

After writing and printing your thesis, the next step is its oral presentation.

1- What a Thesis defense is not:

- A summary of the work

- A presentation of the theoretical and methodological details

- A reading of the thesis

2- What a Thesis defense is:

-A presentation of the entire work

- A lively and concise explanation (around 20 minutes) of:

-The research context

-The motivation for the research

-The methodology

-The main results

-Conclusions and future perspectives.

Unite 3: Introduction to reading and understanding a scientific article

1- What is a Scientific Article?

A scientific article is a published written work intended for experts, specialists, students, and researchers. Its structure and level of reading demand specific skills. Scientific articles typically contain few illustrations, photos, or advertisements. A peer-review committee or group of experts assesses the scientific quality of the article before publication. A brief abstract precedes the main content of the article.

There are different types of scientific articles, such as:

• Original research articles, also known as empirical research (discuss the data collected in actual experiments or observation studies)

• Review articles (discuss current state of research on a given topic)

• Theoretical articles (discuss new or established abstract principles related to a specific field of knowledge)

2-The Structure of a Scientific Article

The first page should include the title, author's name, and the address of the laboratory where the work was conducted.

• The Title

Last but certainly not least, is the title of your article. The title should contain keywords to reflect the main issues in your article. It should also awaken the potential reader's interest, and incite in them the desire to read your work in full. Remember that people searching for publications on a particular topic will generally be using PubMed/Medline or other online repositories, and therefore, your title must contain the principal terms and keywords so that it can easily be identified through PubMed. If the title is badly formulated, your work will not be easily identifiable, and will never be listed in other peoples' search results, with the result that your paper will never be cited by others since they did not find it or read it. Once your title is identified and listed among dozens, if not hundreds of other papers on the same topic, it should distinguish itself from other articles by specifying how your article contributes to the literature or fills a gap in knowledge.

• The Authors

Authors are individuals who actively contributed to the conception of the research work. Typically, the number of authors should not exceed six, based on consensus. The listing of authors should adhere to hierarchical ranking rules.

The initiator and designer of the project should be listed last. Authors who conducted the study and contributed significantly to the work are mentioned first, each with their substantial contribution. Individuals who played a more distant role in the study are acknowledged in the acknowledgments section.

• Abstract

The abstract is a short summary of the article in a few sections (usually background, methods, results, conclusion). It is used for referencing purposes in online bibliographic databases (such as PubMed), and therefore should form an independent unit that is comprehensible as a stand-alone text, without the need to refer to the full text. It is also usually the first item that a potential reviewer will see when being invited to review your paper for publication in a journal. Therefore, it is of paramount important that the abstract be succinct, but informative and attractive, to give the potential reader a foretaste of the main information, and incite the desire to read the full paper. It is the quintessential marketing tool for your work, so it is worth devoting some time and special thought to its preparation.

If you have given sufficient time and thought to preparing your project, and writing the resulting article, the preparation of the abstract should not be time-consuming. Indeed, the hardest part of the abstract is often shortening it sufficiently to fit with the word limit of your target journal.

• Keywords

Keywords are important and informative words related to the content of the article. Reading scientific literature helps increase knowledge and improve critical thinking, requiring an understanding of how a scientific article is structured.

- The vast majority of scientific journals follow the so-called ‘‘IMRAD’’ :

I: Introduction

M: Materials and Methods

R: Results

A: And

D: Discussion.

Naturally, there are some exceptions to this rule, and you should always check the instructions for authors of the journal where you plan to submit your paper to ensure that this is indeed the recommended format. For the purposes of this guide, we will only discuss the IMRAD format, as it is the most widely used. Your article should thus contain (in this order) an introduction, a

methods section, a results section and a discussion. Added to this will be the abstract, which is more or less a summary of these main sections, and of course, the title. At the end, there must be a list of bibliographic references, the tables, and the legends to any figures.

Finally, there may also be some other optional sections, such as acknowledgements, conflicts of interest or authors' contributions.

• Introduction

The introduction is of prime importance in grabbing the reader's attention. In particular during the review process, the introduction must get the reviewer ''hooked'', wanting to read more, and thinking to themselves, ''How come I never thought of this?''. In this section, you will thus explain why you undertook your study, what you aimed to achieve with it, and how this constitutes a useful addition to the existing body of evidence on this topic.

In concrete terms, you should start by explaining briefly, using appropriate references, what is already known about this subject. You should then narrow the field down somewhat and identify the areas where there is still some uncertainty, citing, where appropriate, any previous (and possibly conflicting) data. This will logically lead to a description of an explicit gap in the knowledge that your study hopes to fill. This is an essential element in justifying the utility of your work. Having now explained how your study is going to contribute something new and useful, you should clearly state your working hypothesis, followed by your objective(s), and very briefly, the strategy implemented to achieve these goals

- ✓ **Project Theme:** These are a few sentences (2-3 max.) contextualizing the theme of your report. The introduced subject should initially be somewhat "broad" and then gradually narrow down to the specific issue. Avoid clichés such as "Since time immemorial... Everyone knows that...".
- ✓ **Problem Statement:** Clearly articulate the problem statement of your work in a simple, concise, complete, and precise interrogative sentence that outlines your problem.
- ✓ **Hypotheses:** Describe how you expect the experiment to unfold, the anticipated result(s), possible explanations, etc. Your hypotheses should be verifiable and capable of addressing your problem statement.

• Materials and Methods

The objective of the methods section is to describe exactly what you did, and how, in sufficient detail such that any average reader with the same resources at their disposal would be able to reproduce your study. There must be a method described for every result you intend to include

in your results section – i.e., you cannot present the results of a test or analysis that was not mentioned in the methods. Conversely, if details of any or all procedures have previously been published elsewhere, then a brief summary will suffice, accompanied by a reference to the relevant publication.

As regards the tense to use for your writing, the methods should mainly be described using the past (imperfect) tense, i.e. we performed, we recorded, we measured, we tested. . . The pastperfect tense should be used to describe events occurring before your study, i.e. ‘‘when thrombolysis had failed, we initiated’’.

• Results

The aim of the results section is to describe what you observed, without commentary or discussion. It is no longer necessary to describe the methods; this has already been done in the methods section, so just give the result. The reader will remember what methods were used if they read the methods section attentively. It is also unnecessary to comment, or interpret, so phrases such as ‘‘surprisingly. . .’’ or ‘‘interestingly’’. . . are generally deemed to be out of place in the results section. You must describe a result for every method that was outlined in the methods section, and to make the paper easier to follow and read, it is good practice to present the results in the same order as the methods. Similarly, use of subtitles (again, the same ones as used in the methods section), can help to break down the results into easy-to-follow sections. A typical paragraph of results should start by recalling the type of analysis (e.g. ‘‘QCA analysis revealed that. . .’’), then detail the results observed, referring to the relevant tables or figures (e.g. ‘‘the number of lesions was significantly higher in group A compared to group B’’). As for the methods, the results should be presented using the past (imperfect) tense: e.g. ‘‘serum creatinine was correlated with glomerular filtration rate’’.

A major question for many researchers when writing the results section is whether to describe the results in the text, or use a table or figure. While there are no strict rules for this, in general, results that can easily be described in one or two lines can be written in the text. Tables should be used for data such as baseline characteristics, outcomes, treatments, where the same variables are being described for two or more groups. Tables also generally contain the most important results, and on their own, should be sufficient to give the reader a clear idea of your findings. Figures are useful in cases where the source data is either too complex for presentation or not easily interpretable. Relationships and trends are amenable to graphical presentation in figures. There may be a limit to the total number of illustrations (figures and tables) that you are allowed, depending on the target journal, so again, check for guidance before including too many. Pay

attention also not to include too many illustrations, so that they do not lose their interest, and above all, do not repeat data in the text that already appears in a table or figure.

• Discussion

In this section, a comparison with studies previously identified in the literature review should be presented. Some journals prefer to combine results and discussions into a single chapter.

The objective of the discussion is to address the posed problem statement. As the name suggests, this part should provide a commentary on the obtained results. The discussion should inform whether the results are statistically or clinically significant and identify any potential biases.

This discussion is where you interpret and explain the significance of your results, and how they fit into the wider picture of what has already been observed and reported on the same topic. The discussion should start with a brief recap of the main findings of your study, preferably using the same formulation as that used for the primary objective (in the introduction) and the primary endpoint (in the methods). This can be followed by the

interpretation of your results. Pay attention when interpreting not to simply repeat the results, or at the other end of the scale, not to over-interpret. You should present your findings factually; after all, this is a scientific article, not a prose novel. For example, if you state in your results that ‘‘After administration of drug X, 20 out of 25 patients experienced intracranial bleeding’’, then it is not accurate to indicate in the discussion that ‘‘80% of patients who receive drug X have intracranial hemorrhage’’. This is a subtle shift in interpretation that belies that original data. It would be more accurate, for example, to suggest that ‘‘our results indicate that drug X may have significant adverse effects’’.

For each of the studied parameters, you should:

- Recapitulate the results by citing them and referring to the table and figure numbers.

- Explain these results by comparing them to the existing literature, with references to support your points.

- Recap and validate your hypothesis (refute or confirm).

- Discuss potential sources of errors and critique the methodology if necessary.

- Provide a "mini-conclusion" for each paragraph, highlighting the essential element.

• Conclusions

In this section, the main contributions of the work to addressing the questions and achieving the objectives presented in the introduction are outlined. To draft this section, consider the question: "What should the reader take away from this work?"

Additionally, discuss the perspectives opened up by the obtained results.

• References

Every time you cite statements from an author or a work, you must provide the consulted reference. Since no one has innate knowledge, it is essential to regularly indicate the source from which your information comes. There are various ways to cite a reference, but there is unanimity on one point: footnotes are not used in a scientific report.

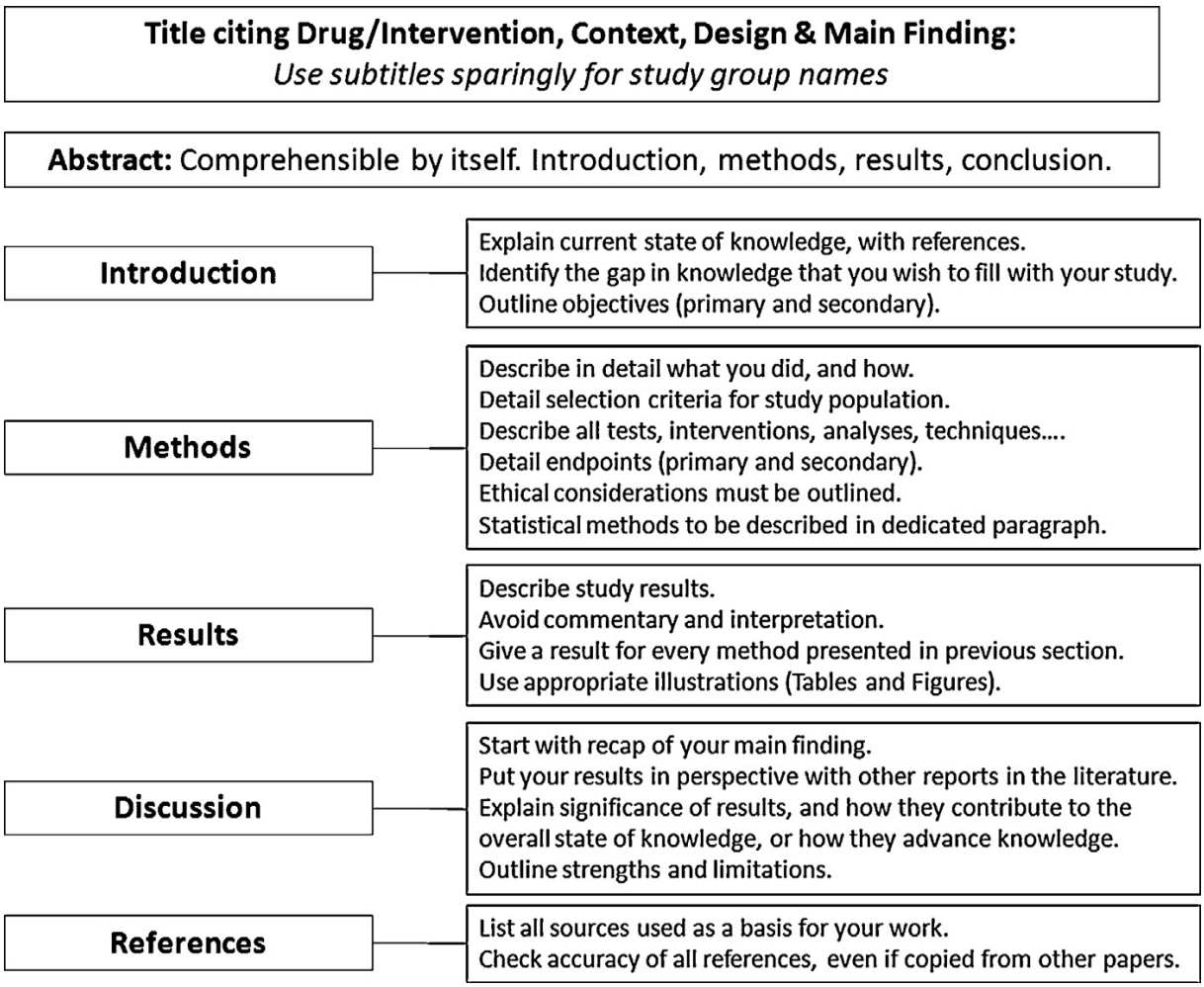


Fig. 1. Summary of basic guidelines regarding the items to include in each section of a scientific manuscript.

3-Introduction to Reading and Understanding a Scientific Article

-A scientific article in a journal or scientific publication may seem complex and difficult to understand if you have little experience in research. However, most scientific articles have a clear structure that greatly facilitates their reading.

-By reading a scientific article in a structured manner, you can better determine if it is relevant and useful for your essay or thesis. In this article, we explain how to read a scientific article.

-If you know that the scientific article is relevant to your research and of good quality, you can delve into a more in-depth reading of the article.

First Step: Read the Introduction of the Scientific Article

-Many students start by reading the abstract, but it is better to begin with the introduction. The abstract is concise and often written in complicated terms, making it challenging to grasp if you haven't read anything else from the rest of the article.

Second Step: Determine the Key Question within the Research Domain

-What is the "big question" that researchers in this field of study aim to answer?

-When you understand the overarching question, you gain a better grasp of the research's motivations discussed in the article. The article is, in fact, just a small part of a much larger study on which other researchers write articles.

-Look for the reasons behind undertaking the research. Often, a study builds upon a previous one. Examine which studies were conducted before, their limitations, and how this new research advances the previous ones. You don't necessarily have to search for this information yourself, as it is often provided in the article itself.

Third Step: Determine the Research Questions of the Scientific Article

-What research questions are the authors specifically trying to answer in the scientific article? There may be multiple questions, or there may be just one. Note the research question(s) on a piece of paper for your reference.

-It is possible that there are no research questions but rather hypotheses. When there are hypotheses instead of research questions, the research aims to determine if the author's expectations (the hypotheses) are correct. In this case, note the hypotheses.

Fourth Step: Consider the Approach:

- What are the authors doing to address the specific questions? What is the plan or approach they have outlined?

Fifth Step: Read the Methodology Section

-Take note of exactly what the authors did for each experiment. For instance, describe this in the form of a clear diagram, ensuring not to miss any details so that you can grasp the overall idea from the diagram. Doing this by hand is quicker than using a computer.

Sixth Step: Read the Results Section of the Scientific Article

-Write one or more paragraphs summarizing the results of each experiment, each figure, and each table. Do not contemplate the significance of the results; simply note them as they are. Often, results are summarized in figures and tables, so study these carefully!

Seventh Step: Determine if the Results Address the Specific Questions

-Form your own interpretations before reading those of the authors (in the discussion section). At this stage, ask yourself what the results mean. If you are a novice in reading scientific articles, this may be more challenging than when you become more experienced.

-In the beginning, you may often need to align your opinion with that of the authors themselves. Later, you will likely become more critical.

Eighth Step: Read the conclusion and discussion of the scientific article

Now, read what the authors think about the significance of the results. Do you agree with their interpretations? Pay attention to what the authors identify as research flaws and their proposed directions for future research. Don't assume they have done everything correctly – be critical.

Have you identified flaws not mentioned by the authors? Do you agree with their suggestions for further research?

9th Step: Go back to the abstract

You can now read the abstract. Does it reflect what the authors state in the article? Does the abstract correspond to your interpretation of the scientific article?

10th Step: Save the scientific article and note the source reference

Now that you have read the article thoroughly, is it relevant and useful for your research?

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